

## PENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION  
(PCT Rule 61.2)

Date of mailing (day/month/year) 06 June 2001 (06.06.01)	To:  Commissioner US Department of Commerce United States Patent and Trademark Office, PCT 2011 South Clark Place Room CP2/5C24 Arlington, VA 22202 ETATS-UNIS D'AMERIQUE  in its capacity as elected Office
International application No. PCT/GB00/02868	Applicant's or agent's file reference
International filing date (day/month/year) 28 July 2000 (28.07.00)	Priority date (day/month/year) 29 July 1999 (29.07.99)
Applicant MACAULEY, Stephen et al	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

28 February 2001 (28.02.01)

in a notice effecting later election filed with the International Bureau on:

\_\_\_\_\_

2. The election  was

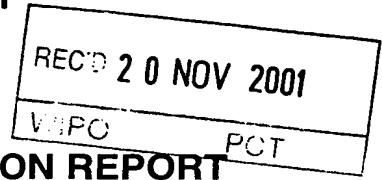
was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer  Olivia TEFY  Telephone No.: (41-22) 338.83.38
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**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**



(PCT Article 36 and Rule 70)

Applicant's or agent's file reference /.	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/02868	International filing date (day/month/year) 28/07/2000	Priority date (day/month/year) 29/07/1999
International Patent Classification (IPC) or national classification and IPC F04B43/02		
Applicant MUNSTER SIMMS ENGINEERING LIMITED et al.		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the report</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input checked="" type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input checked="" type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII <input type="checkbox"/> Certain observations on the international application</li> </ul>

Date of submission of the demand 28/02/2001	Date of completion of this report 16.11.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Gnüchtel, F Telephone No. +49 89 2399 2012



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB00/02868

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):  
**Description, pages:**

1-7                   as originally filed

**Claims, No.:**

1-13                   as originally filed

**Drawings, sheets:**

1/7-7/7               as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description,           pages:
- the claims,               Nos.:

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International application No. PCT/GB00/02868

the drawings, sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):  
*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

### III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

the entire international application.

claims Nos. 13.

because:

the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 13 are so unclear that no meaningful opinion could be formed (*specify*):  
**see separate sheet**

the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

the written form has not been furnished or does not comply with the standard.

the computer readable form has not been furnished or does not comply with the standard.

### IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

restricted the claims.

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EXAMINATION REPORT**

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- paid additional fees.
- paid additional fees under protest.
- neither restricted nor paid additional fees.

2.  This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- complied with.
- not complied with for the following reasons:  
**see separate sheet**

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- all parts.
- the parts relating to claims Nos. .

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	2,3,4,5,8,9,11,12
	No:	Claims	1,6,7,10
Inventive step (IS)	Yes:	Claims	2,3,4,5,8,9,11,12
	No:	Claims	1,6,7,10

Industrial applicability (IA)

Yes:	Claims	1-13
No:	Claims	

2. Citations and explanations  
**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/02868

**Cited Documents**

The following document indicated in the international search report is referred to in this international preliminary examination report:

**D1 US-A-4,610,605 (Hartley)**

**Re Item III**

**Non-establishment of opinion**

III.1 According to Rule 6.2(a) PCT, claims shall not rely on references to the description or drawings, except where "absolutely necessary". The present examining Authority considers that for the subject-matter of the present international application it is not "absolutely necessary" to rely on such references, since it does not fall under the exception indicated in the PCT Guidelines for Preliminary International Examination III-4.10.

In the contrary, these references introduce a lack of clarity in the sense of Article 6 PCT, such that no meaningful examination of the subject-matter thus defined is possible. For example, it is unclear which particular structural features, and in which combination, are to be considered from the description/drawings. Hence, no examination of the present international application in respect of claim 13 has and will be carried out.

**Re Item IV**

**Lack of unity of invention**

IV.1 The present Examining Authority agrees with the objection put forward by the Search Authority with communication dated 04.12.2000, as to a lack of unity of invention within the meaning of Rule 13(1),(2) PCT.

IV.2 The present international application contains the following three (groups of) inventions:

1. Claims 1-7, 10:

A diaphragm pump, wherein the diaphragm is provided with a lug formation and the

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/02868

mating surfaces of the piston sections are provided with complementary shaped slots for engagement.

**2. Claims 8, 9:**

A diaphragm pump, wherein the casing has feet of the ovoid shape and resilient material.

**3. Claims 11, 12:**

A diaphragm pump, with a microswitch for stopping the pump.

**Re Item V**

**Reasoned statement under Article 35(2) PCT with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

V.1 The present international application does not meet the requirements of the PCT, because the subject-matter of independent claim 1 is not new in the sense of Article 33(2) PCT.

Document D1, considered the closest prior art, discloses:

- a diaphragm pump 11 (Fig. 1,2);
- a two part casing comprising a front cover 29 and a back cover 27,25 (Fig. 1,2);
- a diaphragm plate 33 extending across the front 29 and back 27 covers and being secured therebetween when the covers are fastened together (Fig. 2,3);
- the diaphragm plate 33 having a plurality of similarly defined circular regions 61,61a,61b (Fig. 6);
- the front cover 29 having substantially axially aligned inlet 19 and outlet 21 ports, said inlet port 19 leading to an inlet chamber 89; and said outlet port 21 leading to an outlet chamber 91 (Fig. 1,4);
- a valve housing 31 securable inside the front cover 29 (Fig. 2,3);

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EXAMINATION REPORT - SEPARATE SHEET**

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- said valve housing 31 having defined therein an outlet dished valve seat 101 with a correspondingly concave resilient outlet valve 93,97 seated therein, the outlet valve seat 101 having fluid passages 85 therethrough (Figs. 2-4; column 4, lines 57-68);
- said valve housing 31 having defined therein a plurality of inlet valve seats (not numbered) equal in number to the number of circular regions 61,61a,61b, each being similarly dished and having a correspondingly concave resilient valve 87,88 seated therein each inlet valve seat having fluid passages 83 therethrough (Figs. 2-6; column 4, lines 41-52);
- the outlet valve 93,97 being in fluid communication with the outlet chamber 91, and the inlet valves 87,88 being in fluid communication with the inlet chamber 89 (Fig. 3; column 4, lines 52-56);
- a wobble plate 49 positioned in the back cover 27,25 and having a central boss 57 and a plurality of similar piston sections 59 equal in number to the number of circular regions 61,61a,61b on the diaphragm plate 33, the piston sections 59 and circular regions 61,61a,61b being correspondingly secured together (Fig. 2; column 3, line 66 to column 4, line 3; and column 4, lines 38-41);
- the wobble plate 49 being subject to nutating motion to cause reciprocating action by the circular regions and provide pumping action (column 5, lines 32-37).

Hence, all the technical features of independent claim 1 are disclosed in document D1 and therefore its subject-matter is not new in the sense of Article 33(2) PCT.

V.2 The combinations of features as defined in respective dependent claims 2, 3, 4, 5, 8, 9, 11 and 12 appears to be not known from any of the documents cited in the international search report, does not appear to be rendered obvious by any of these documents alone or in combination, and is not considered matter of normal design procedure.

V.3 The subject-matter of respective dependent claims 6, 7 and 10 appears to lack novelty in the sense of Article 33(2) PCT, since the respective additional features introduced in these claims seem to be also known from document D1.

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**Re Item VII**

**Certain defects in the international application**

- VII.1 The independent claim is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the closest prior art document **D1** being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
- VII.2 The technical features of the claims are not provided with reference signs to the drawings placed in parentheses as required by Rule 6.2(b) PCT.
- VII.3 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in document **D1** is not mentioned in the description, nor is this document identified therein.

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No.	International filing date (day/month/year)	(Earliest) Priority Date (day/month/year)
PCT/GB 00/ 02868	28/07/2000	29/07/1999
Applicant		
MUNSTER SIMMS ENGINEERING LIMITED et al.		
<p>This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.</p> <p>This International Search Report consists of a total of <u>6</u> sheets.  <input checked="" type="checkbox"/> It is also accompanied by a copy of each prior art document cited in this report.</p>		
<p><b>1. Basis of the report</b></p> <p>a. With regard to the <b>language</b>, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.</p> <p><input type="checkbox"/> the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).</p> <p>b. With regard to any <b>nucleotide and/or amino acid sequence</b> disclosed in the international application, the international search was carried out on the basis of the sequence listing :</p> <p><input type="checkbox"/> contained in the international application in written form.</p> <p><input type="checkbox"/> filed together with the international application in computer readable form.</p> <p><input type="checkbox"/> furnished subsequently to this Authority in written form.</p> <p><input type="checkbox"/> furnished subsequently to this Authority in computer readable form.</p> <p><input type="checkbox"/> the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.</p> <p><input type="checkbox"/> the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished</p> <p>2. <input type="checkbox"/> Certain claims were found unsearchable (See Box I).</p> <p>3. <input checked="" type="checkbox"/> Unity of invention is lacking (see Box II).</p> <p>4. With regard to the <b>title</b>,</p> <p><input checked="" type="checkbox"/> the text is approved as submitted by the applicant.</p> <p><input type="checkbox"/> the text has been established by this Authority to read as follows:</p> <p>5. With regard to the <b>abstract</b>,</p> <p><input type="checkbox"/> the text is approved as submitted by the applicant.</p> <p><input checked="" type="checkbox"/> the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.</p> <p>6. The figure of the <b>drawings</b> to be published with the abstract is Figure No. <u>4b</u></p> <p><input type="checkbox"/> as suggested by the applicant.</p> <p><input type="checkbox"/> because the applicant failed to suggest a figure.</p> <p><input checked="" type="checkbox"/> because this figure better characterizes the invention.</p> <p><input type="checkbox"/> None of the figures.</p>		

**INTERNATIONAL SEARCH REPORT**International application No.  
PCT/GB 00/02868**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

As a result of the prior review under R. 40.2(e) PCT,  
no additional fees are to be refunded.

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest** The additional search fees were accompanied by the applicant's protest. No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-7,10

The diaphragm is provided with a lug formation and the mating surfaces of the piston sections are provided with complementary shaped slots for engagement

2. Claims: 8,9

The casing has feet of ovoid shape and resilient material

3. Claims: 11,12

A microswitch for stopping the pump

**INTERNATIONAL SEARCH REPORT**

International application No.

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**Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)**

A diaphragm pump comprises a two part casing formed of a front cover (10) and a back cover (12). A diaphragm plate (14) having a plurality of circular regions (16) extends across the covers (10,12) with axially aligned inlet and outlet ports (18) leading to inlet and outlet chambers (22,24), a valve housing (26) with a concave resilient disk outlet valve (30) and a plurality of inlet disk valves (36). A wobble plate (40) is positioned in the back cover (12) with a central boss (42) for connection to the electric motor (76). The wobble plate (40) provides a pumping action by a nutating movement which displaces the pistons (44). The circular diaphragm sections have lugs (46) of cruciform shape which are secured to corresponding slots (48) in the pistons (44). The motor casing has a mounting bracket (56) with mounting feet (58) of ovoid shape and resilient material and an integrated pressure switch for stopping the pump by activation of a micro-switch.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02868

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 F04B43/02 F04B1/12

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 F04B F16M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 610 605 A (HARTLEY E DALE) 9 September 1986 (1986-09-09) the whole document ----	1,6,7,10
Y	EP 0 744 547 A (AQUATEC WATER SYSTEMS INC) 27 November 1996 (1996-11-27) column 2, line 24 - line 39 column 4, line 23 -column 6, line 45; figures 3-16 ----	1,2,4,5
A	column 2, line 24 - line 39 column 4, line 23 -column 6, line 45; figures 3-16 ----	8
Y	DE 196 34 922 A (KNF NEUBERGER GMBH) 5 March 1998 (1998-03-05) column 2, line 54 -column 3, line 8 column 3, line 29 -column 4, line 61; figure 1 ----	1,2,4,5
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

2 February 2001

Date of mailing of the international search report

16.02.2001

Name and mailing address of the ISA  
 European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Jungfer, J

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02868

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 801 249 A (KAKIZAWA GORO) 31 January 1989 (1989-01-31) column 3, line 28 - line 50; figures 4-6 ----	1-5
A	JP 04 262076 A (MITSUBISHI ELECTRIC CORP) 17 September 1992 (1992-09-17) figures 1-11 ----	1,8
A	EP 0 402 577 A (TECUMSEH PRODUCTS CO) 19 December 1990 (1990-12-19) column 3, line 7 - line 55; figures 1,2 column 5, line 42 -column 6, line 40 ----	1,8
A	EP 0 830 902 A (BLACK & DECKER INC) 25 March 1998 (1998-03-25) column 5, line 1 - line 38; figures 5,6 ----	1,11,12
A	US 4 730 999 A (TSUKUDA YOSHIAKI ET AL) 15 March 1988 (1988-03-15) column 3, line 25 -column 4, line 12 column 4, line 61 -column 5, line 6 figures 1-9 ----	1,11,12
A	US 2 042 510 A (CORNELIUS, R.T. ET AL.) 2 June 1936 (1936-06-02) page 1B, line 52 -page 2A, line 3 page 3B, line 24 -page 4A, line 68; figures 1-5 ----	1,11,12
A	US 1 992 491 A (LINDSAY, L.G.) 26 February 1935 (1935-02-26) the whole document ----	1,11,12
A	US 4 247 260 A (SCHOENWALD SIEGFRIED ET AL) 27 January 1981 (1981-01-27) the whole document -----	1,11,12

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International Application No

PCT/GB 00/02868

Patent document cited in search report	Publication date	Patent family member(s)			Publication date
US 4610605 A	09-09-1986	CA 1242929 A	DE 3575770 D	EP 0210315 A	11-10-1988 08-03-1990 04-02-1987
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		US 5649812 A	US 6089838 A		22-07-1997 18-07-2000
DE 19634922 A	05-03-1998	WO 9809078 A	EP 0922164 A	JP 2000502778 T	05-03-1998 16-06-1999 07-03-2000
		US 6065389 A			23-05-2000
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JP 04262076 A	17-09-1992	NONE			
EP 0402577 A	19-12-1990	US 4964609 A	BR 9001934 A	CA 1317470 A	23-10-1990 30-07-1991 11-05-1993
EP 0830902 A	25-03-1998	GB 2309493 A			30-07-1997
US 4730999 A	15-03-1988	JP 62032287 A	JP 62055214 A		12-02-1987 10-03-1987
US 2042510 A	02-06-1936	NONE			
US 1992491 A	26-02-1935	NONE			
US 4247260 A	27-01-1981	DE 2810738 A	AT 370162 B	AU 523893 B	20-09-1979 10-03-1983 15-07-1982 19-08-1982
		AU 4502879 A	DK 537978 A	EP 0004056 A	20-09-1979 14-09-1979 19-09-1979
		ES 478580 A	FI 783906 A	IN 150549 A	01-06-1979 14-09-1979 13-11-1982
		JP 54128001 A	NO 790788 A		04-10-1979 14-09-1979

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
8 February 2001 (08.02.2001)

PCT

(10) International Publication Number  
**WO 01/09510 A2**

(51) International Patent Classification<sup>7</sup>: **F04B**

(21) International Application Number: **PCT/GB00/02868**

(22) International Filing Date: 28 July 2000 (28.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
9917736.2 29 July 1999 (29.07.1999) GB

(71) Applicant (*for all designated States except US*): **MUNSTER SIMMS ENGINEERING LIMITED [GB/GB]**; Old Belfast Road, Bangor, County Down BT19 1LT (GB).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **MACAULEY, Stephen [GB/GB]**; Old Belfast Road, Bangor, County

Down BT19 1LT (GB). EVASON, Michael [GB/GB]; Unit 3, Weavers Court Business Park, Linfield Road, Belfast BT12 5GL (GB). MCFARLAND, Robert, Stanley [GB/GB]; Old Belfast Road, Bangor, County Down BT19 1LT (GB).

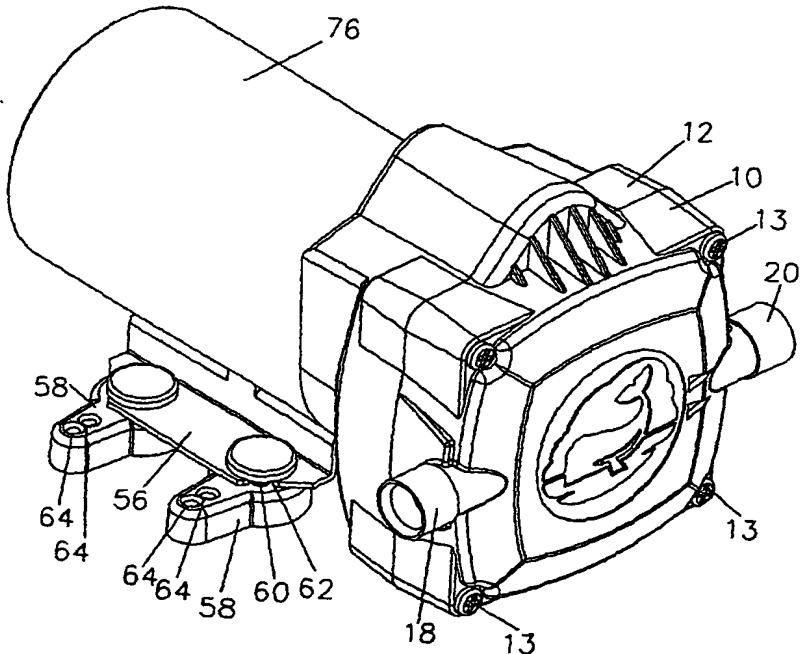
(74) Agent: **ROBERTSON, Robert, Bruce, Spence**; 240 Upper Newtownards Road, Belfast BT4 3EU (GB).

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[Continued on next page]

(54) Title: DIAPHRAGM PUMPS





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resilient valve (30) seated therein. The outlet valve seat (28) has fluid passages therethrough. A plurality of inlet valve seats (34) is provided, equal in number to the number of regions, each being similarly dished and having a correspondingly concave resilient valve (36) seated therein. Each inlet valve seat (34) has fluid passages therethrough. The outlet valve (30) is in fluid communication with the outlet chamber (24) and the inlet valves (36) are in fluid communication with the inlet chamber (22). A wobble plate (40) is positioned in the back cover (12) and has a central boss (42) and a plurality of similar piston sections (44) equal in number to the number of circular regions (16) on the diaphragm plate (14). The piston sections (44) and circular regions (16) are correspondingly secured together. The wobble plate (40) is subject to nutating motion to cause reciprocating action by the circular regions (16) and provide a pumping action.

IND A1

SUB A2

DIAPHRAGM PUMPS

This invention relates to a diaphragm pump incorporating a wobble plate.

Accordingly, the present invention is a diaphragm pump comprising a two part casing formed of a front cover and a back cover, a diaphragm plate extending across the covers and being secured therebetween when the covers are fastened together, the diaphragm plate having a plurality of similarly defined circular regions,

- 5 the front cover having substantially axially aligned inlet and outlet ports, each leading to mutually exclusive inlet and outlet chambers respectively, a valve housing securable inside the front cover and having defined therein an outlet dished valve seat with a correspondingly concave resilient valve seated therein, the outlet valve seating having fluid passages therethrough, and a plurality of inlet valve seats, equal
- 10 in number to the number of regions, each being similarly dished and having a correspondingly concave resilient valve seated therein, each inlet valve seat having fluid passages therethrough, the outlet valve being in fluid communication with the outlet chamber and the inlet valves being in fluid communication with the inlet chamber, and a wobble plate positioned in the back cover and having a central boss
- 15 and a plurality of similar piston sections equal in number to the number of circular regions on the diaphragm, the piston sections and circular regions being correspondingly secured together, the wobble plate being subject to nutating motion to cause reciprocating action by the circular regions and provide a pumping action.

IND A3

- 20 Preferably, the circular regions of the diaphragm are each provided with an outstanding lug formation and the mating surfaces of the piston sections of the wobble plate are provided with complimentary shaped slots, the securement being formed when the lug formation of each region is engaged in the slot of the

corresponding piston section. The lug formation of each diaphragm and the slot of each corresponding piston section is beneficially of cruciform shape. The outer ends of the lug formation are desirably of greater length than the slots to provide a locking means in the slots. A rear diaphragm support plate may be provided in the 5 back cover, the support plate having an equal number of similar apertures to the number of circular regions, each aperture having a walled surround, the circular regions fitting into respective apertures and being supported thereby.

Preferably also, the wobble plate boss seats and holds a bearing having a ball race, the boss having an inwardly-extending retaining flange.

10 Preferably also, the casing is secured to an electric motor with the drive shaft connected to the bearing. The casing has desirably a mounting bracket with a series of mounting feet fitted thereto, the feet each being substantially ovoid in plan and of resilient material, the greater dimensioned end having an upstanding headed stub pillar, each pillar mating in a open slot in the bracket, the slot being narrower at 15 its open end to hold the respective foot in its slot. The feet are desirably similarly provided with at least one fixing hole at their narrower end and being capable of rotating about their respective mating slot.

Preferably further, the valve housing is fixed to the front cover by a screw. An integral pressure switch is beneficially provided in the back cover with the 20 diaphragm plate being provided with a fifth defined circular region, smaller than the others, the rear diaphragm support plate having a similarly shaped aperture with wall surround to accommodate a micro-switch activated by movement of the fifth circular region serving as a pressure switch pad, the electrical wires to the micro-switch being fed internally from the front face of the motor. The valve housing, on the same 25 side as the inlet valve seats are positioned, is preferably provided with a track leading from a hole exiting on that side and centrally provided in the outlet valve seat

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provided on the opposite side, the track mating with a corresponding track provided on the diaphragm plate, the mated tracks forming a passage between the hole and the fifth circular region whereby any fluid leaving the outlet chamber when under pressure through the screw travels along the passage and fills a void at the pressure pad on the opposite side of the diaphragm plate from the pressure switch causing activation of the micro-switch to stop the pump.

*Ans  
24*  
An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figs. 1A and 1B are perspective views from above and from below of a front cover of a diaphragm pump according to the present invention;

Figs. 2A and 2B are respectively perspective views from above and from below of a back cover of the pump;

*SUB  
AS*  
Figs. 3A and 3B are respectively perspective views from above and from below of a valve housing of the pump;

Figs. 4A and 4B are respectively perspective views from above and from below of a diaphragm plate of the pump;

Figs. 5A and 5B are respectively perspective views from above and from below of a diaphragm support plate of the pump;

Figs. 6A, 6B and 6C are respectively a perspective view from above, a perspective view from below, and a cross-sectional view of a wobble plate of the pump;

Figs. 7A and 7B are respectively a perspective view from above and from below of an eccentric positioned between a wobble plate and the drive shaft of an electric motor;

*Sub  
B*  
Fig 8 is a perspective view of an assembled pump; and

Fig. 9 is a modified diaphragm support plate,

Referring to the drawings, a diaphragm pump comprises a two part casing formed of a front cover 10 and a back cover 12. A diaphragm plate 14 extends across and between the covers 10, 12 and is secured therebetween when the covers 10, 12 are fastened together by screw fasteners 13. The diaphragm plate 14 has a plurality of four similarly defined circular regions 16.

The front cover 10 has substantially axially aligned inlet and outlet ports 18, 20, each leading to a mutually exclusive inlet and outlet chambers 22, 24, respectively. The outlet chamber 24 is provided centrally of the front cover 10 and has a wall surround 25 through which the outlet port 20 communicates. The inlet chamber 22 is defined between the wall surround 25 and a wall of the front cover 10.

A valve housing 26 is substantially planar and is secured inside the front cover 10 and has defined therein on one side an outlet dished valve seat 28 with a correspondingly concave resilient valve 30 seated therein. The outlet valve seat 28 has a gridded area 32 forming fluid passages therethrough and a central hole 72. On the opposite side of the housing 26, a plurality of four inlet valve seats 34 are provided; each being similarly dished and having a correspondingly concave resilient valve 36 seated therein, each inlet valve seat 34 having arcuate gridded areas 38 forming fluid passages therethrough and a central hole 73. The outlet valve seat 28 is in fluid communication with the outlet chamber 24 and the inlet valve seats 34 are in fluid communication with the inlet chamber 22. Each valve 30 and 36 is formed of a dished, part-spherical portion having a post 35 radially outstanding from its rear face, the post having a bulbous portion 37, the valve being seated by the post 35 being pushed through the hole 72, 73 respectively with the bulbous portion 37 holding the valve in position preventing unintentional removal.

A wobble plate 40 is positioned in the back cover 12 and has a central boss 42 and a plurality of four similar piston sections 44. The piston sections 44 and

circular regions 16 are correspondingly secured together. The wobble plate 40 is subject to nutating motion, like 'four cylinders', to cause reciprocating action by the circular regions 16 of the diaphragm plate 14 sequentially and provide a pumping action.

5        The circular regions 16 of the diaphragm 14 are each provided with an outstanding lug formation 46 and the mating surfaces of the piston sections 44 of the wobble plate 40 are provided with complementary shaped slots 48. The securement between them is formed when the lug formation 46 of each region 16 is engaged in the slot 48 of the corresponding piston section 44. The lug formation 46 of each 10 diaphragm 14 and the slot 48 of each corresponding piston section 44 is of cruciform shape. The outer ends of the lug formation 46 are of greater length than the slots 48 to provide a locking means with the slots 48.

15      A rear diaphragm support plate 50 is provided in the back cover 12, the support plate 50 having four similar apertures 52. Each aperture 52 has a walled surround with the circular regions 16 fitting into respective apertures 52.

The boss 42 of the wobble plate 40 seats and holds by an inwardly-extending retaining flange 56 a bearing 54 having a ball race, the bearing 54 having been insert moulded in the boss 42.

20      The back cover 12 of the casing is secured to an electric motor 76 with the drive shaft connected via an eccentric 78 to the bearing 54 through the back cover 12. The eccentric 78 has a knurled portion 79 to fit into the wobble plate 40 with the drive shaft of the motor locating in bore 81. The motor 76 has a mounting bracket 56 with a series of mounting feet 58 fitted thereto, the feet 58 each being substantially ovoid in plan and of resilient material to dampen vibratory movement. 25      The greater dimensioned end of each foot 58 has an upstanding headed stub pillar 60, the pillar 60 mating in an open slot 62 in the bracket 56. The slot 62 is narrower

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at its open end to hold the respective foot 58 in the slot. The feet 58 are similarly provided with two fixing holes 64 at their narrower end and being capable of rotating in and about their respective mating slot 62.

The valve housing 26 is fixed to the front cover 10 by a screw (not shown).

5 An integral pressure switch (not shown) is provided in the back cover 12 with the diaphragm plate 14 being provided with a fifth defined circular region 66, smaller than the other regions 16, the rear diaphragm support plate 50 having a similarly shaped aperture 68 with wall surround to accommodate the circular region 66. A micro-switch (not shown) is retained in an enclosure 82 on the back cover 12 by an  
10 upstand 80 in the rear diaphragm support plate 50 is activated by movement of the fifth circular region 66 serving as a pressure switch pad, the electrical wires to the micro-switch being fed internally from the front face of the motor. The valve housing 26, on the same side as the inlet valve seats 34 are positioned, is provided with a track 70 between two inlet valve seats 34 leading from a hole 72 exiting on that side  
15 and centrally provided in the outlet valve seat 28 provided on the opposite side, the track 70 mating with a corresponding track 74 provided on the diaphragm plate 14. The mated tracks 70, 74 form a passage between the hole 72 and the fifth circular region 66 whereby any fluid leaving the outlet chamber 24 when under pressure through the screw travels along the passage and fills a void at the pressure pad on  
20 the opposite side of the diaphragm plate 14 from the pressure switch causing activation of the micro-switch to stop the pump.

In use, with the inlet and outlet ports connected to a supply source and a demand requirement and the motor connected up to a supply of electricity, the pump can be switched on to pump, in an even flow, fluid, normally water, from the supply  
25 source. The motor drives the wobble plate to nutate and reciprocate the piston sections and circular regions of the diaphragm plate in a pumping action.

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In a first modification, the concave resilient valve 30 and post 35 is provided with a bore strengthened by a metallic tubular liner through which the valve 30 and valve housing 26 is secured by a fastening (not shown) through a washer to the front cover 10.

5        In a second modification, the valve housing 26, the diaphragm plate 14 and the diaphragm support plate 50 are provided with five apertures (not shown) and are secured together by five fastenings (not shown) into respective bosses 90 provided on the support plate 50 (as shown in Fig. 9), the fastenings being fixed in the opposite direction to the fastening of the valve housing 26 and valve 30.

10      In a third modification, the lug formations 46 and slots 48 are omitted and the piston sections 44 are each screw fastened to respective circular regions 16 of the diaphragm 14.

Variations and modifications can be made without departing from the scope of the invention described above and as claimed hereinafter.

15

CLAIMS

*Add A*

1. A diaphragm pump comprising a two part casing formed of a front cover and a back cover, a diaphragm plate extending across the covers and being secured therebetween when the covers are fastened together, the diaphragm plate having a plurality of similarly defined circular regions, the front cover having substantially axially aligned inlet and outlet ports, each leading to mutually exclusive inlet and outlet chambers respectively, a valve housing securable inside the front cover and having defined therein an outlet dished valve seat with a correspondingly concave resilient valve seated therein, the outlet valve seating having fluid passages therethrough, and a plurality of inlet valve seats, equal in number to the number of regions, each being similarly dished and having a correspondingly concave resilient valve seated therein, each inlet valve seat having fluid passages therethrough, the outlet valve being in fluid communication with the outlet chamber and the inlet valves being in fluid communication with the inlet chamber, and a wobble plate positioned in the back cover and having a central boss and a plurality of similar piston sections equal in number to the number of circular regions on the diaphragm, the piston sections and circular regions being correspondingly secured together, the wobble plate being subject to nutating motion to cause reciprocating action by the circular regions and provide a pumping action.
2. A pump as claimed in Claim 1, wherein the circular regions of the diaphragm are each provided with an outstanding lug formation and the mating surfaces of the piston sections of the wobble plate are provided with complimentary shaped slots, the securement being formed when the lug formation of each region is engaged in the slot of the corresponding piston section.

3. A pump as claimed in Claim 2, wherein the lug formation of each diaphragm and the slot of each corresponding piston section is of cruciform shape.

5 4. A pump as claimed in Claim 2 or 3, wherein the outer ends of the lug formation are of greater length than the slots to provide a locking means in the slots.

5. A pump as claimed in Claim 1, 2 or 3, wherein a rear diaphragm support plate

10 is provided in the back cover, the support plate having an equal number of similar apertures to the number of circular regions, each aperture having a walled surround, the circular regions fitting into respective apertures and being supported thereby.

15 6. A pump as claimed in any one of the preceding Claims, wherein the wobble plate boss seats and holds a bearing having a ball race, the boss having an inwardly-extending retaining flange.

7. A pump as claimed in any one of the preceding Claims, wherein the casing is secured to an electric motor with the drive shaft connected to the bearing.

20 8. A pump as claimed in any one of the preceding Claims, wherein the casing has a mounting bracket with a series of mounting feet fitted thereto, the feet each being substantially ovoid in plan and of resilient material, the greater dimensioned end having an upstanding headed stub pillar, each pillar mating in a open slot in the

25 bracket, the slot being narrower at its open end to hold the respective foot in its slot.

9. A pump as claimed in Claim 8, wherein the feet are similarly provided with  
at least one fixing hole at their narrower end and being capable of rotating about their respective mating slot.

5

10. A pump as claimed in any one of the preceding Claims, wherein the valve housing is fixed to the front cover by a screw.

11. A pump as claimed in any one of the preceding Claims, wherein an integral pressure switch is provided in the back cover with the diaphragm plate being provided with a fifth defined circular region, smaller than the others, the rear diaphragm support plate having a similarly shaped aperture with wall surround to accommodate a micro-switch activated by movement of the fifth circular region serving as a pressure switch pad, the electrical wires to the micro-switch being fed internally from the front face of the motor.

12. A pump as claimed in any one of the preceding Claims, wherein the valve housing, on the same side as the inlet valve seats are positioned, is provided with a track leading from a hole exiting on that side and centrally provided in the outlet 20 valve seat provided on the opposite side, the track mating with a corresponding track provided on the diaphragm plate, the mated tracks forming a passage between the hole and the fifth circular region whereby any fluid leaving the outlet chamber when under pressure through the screw travels along the passage and fills a void at the pressure pad on the opposite side of the diaphragm plate from the pressure switch 25 causing activation of the micro-switch to stop the pump.

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13. A diaphragm pump substantially as hereinbefore described with reference  
to the accompanying drawings.

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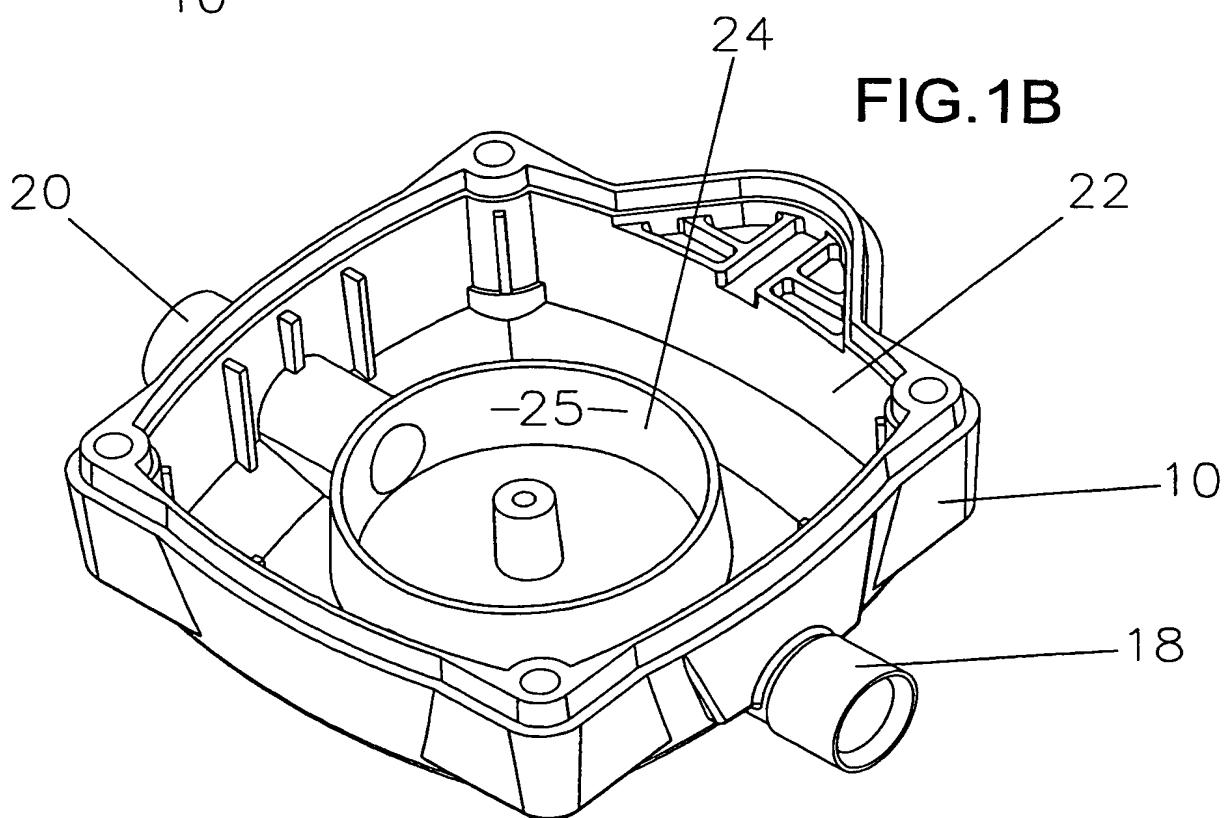
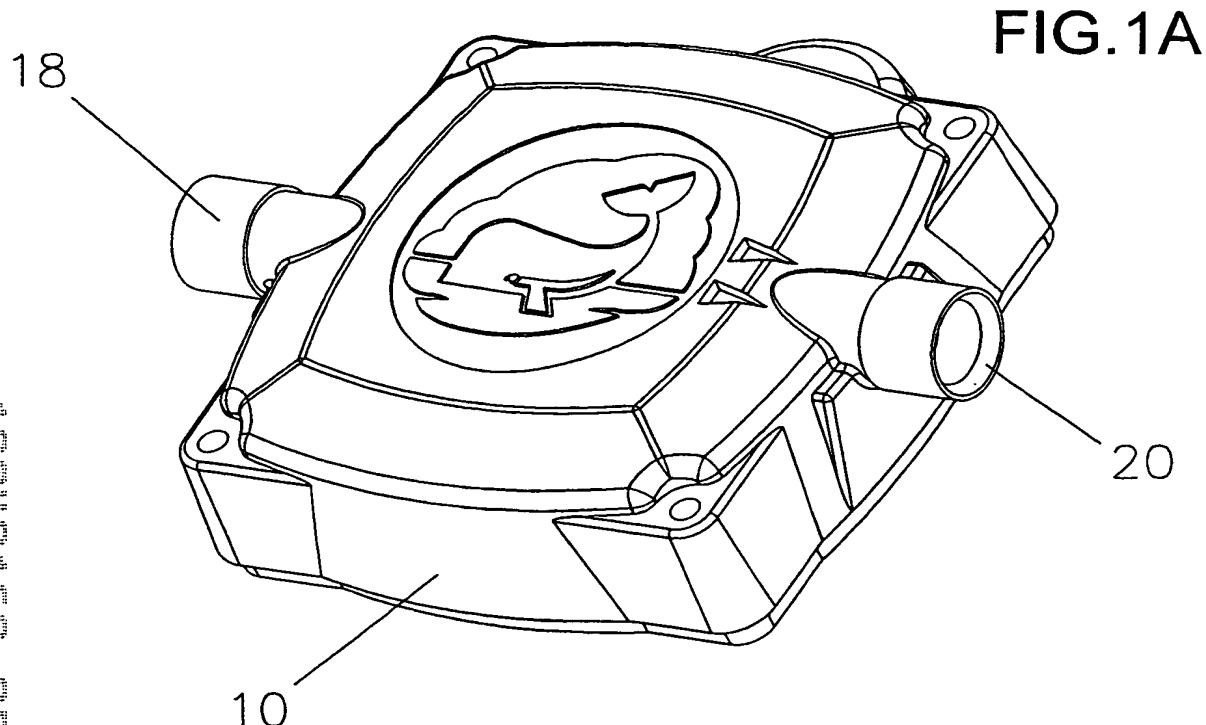
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## ABSTRACT OF THE DISCLOSURE

A diaphragm pump comprises a two part casing formed of a front cover and a back cover. A diaphragm plate extends across the covers and is secured therebetween when the covers are fastened together. The diaphragm plate has a plurality of similarly defined circular regions. The front cover has substantially axially aligned inlet and outlet ports, each leading to mutually exclusive inlet and outlet chambers respectively. A valve housing is securable inside the front cover and has defined therein an outlet dished valve seat with a correspondingly concave resilient valve seated therein. The outlet valve seat has fluid passages therethrough. A plurality of inlet valve seats is provided, equal in number to the number of regions, each being similarly dished and having a correspondingly concave resilient valve seated therein. Each inlet valve seat has fluid passages therethrough. The outlet valve is in fluid communication with the outlet chamber and the inlet valves are in fluid communication with the inlet chamber. A wobble plate is positioned in the back cover and has a central boss and a plurality of similar piston sections equal in number to the number of circular regions on the diaphragm plate. The piston sections and circular regions are correspondingly secured together. The wobble plate is subject to nutating motion to cause reciprocating action by the circular regions and provide a pumping action.

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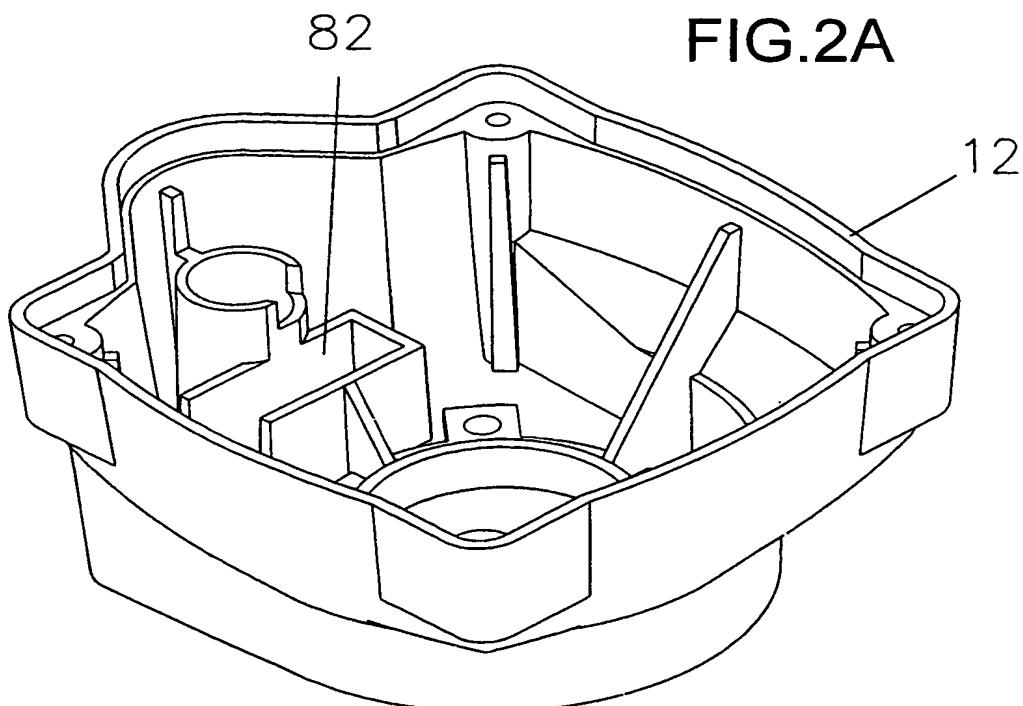
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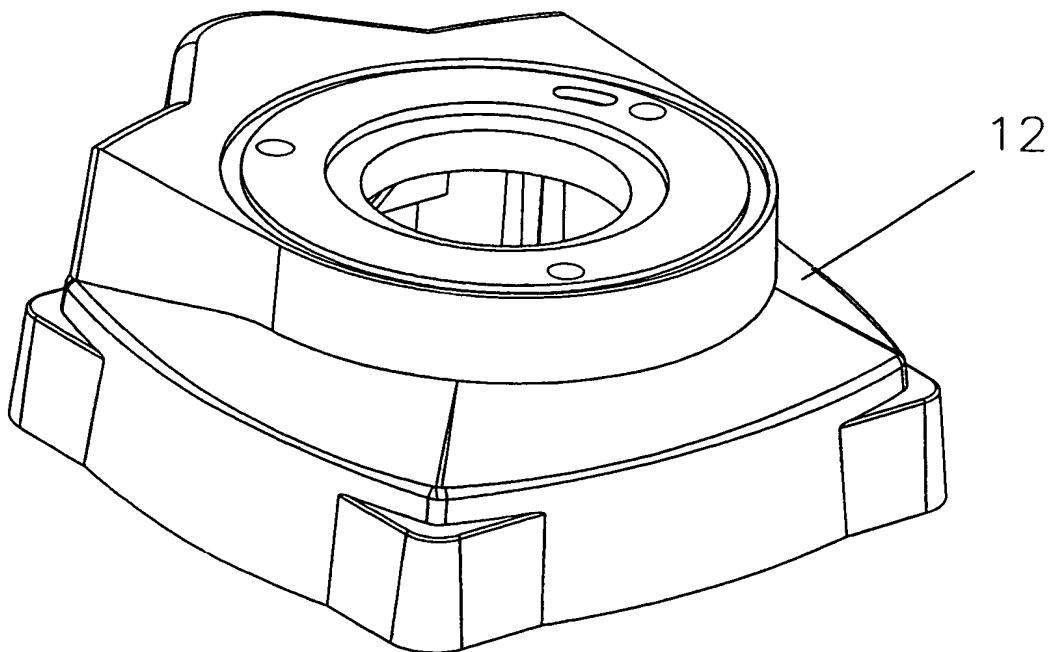
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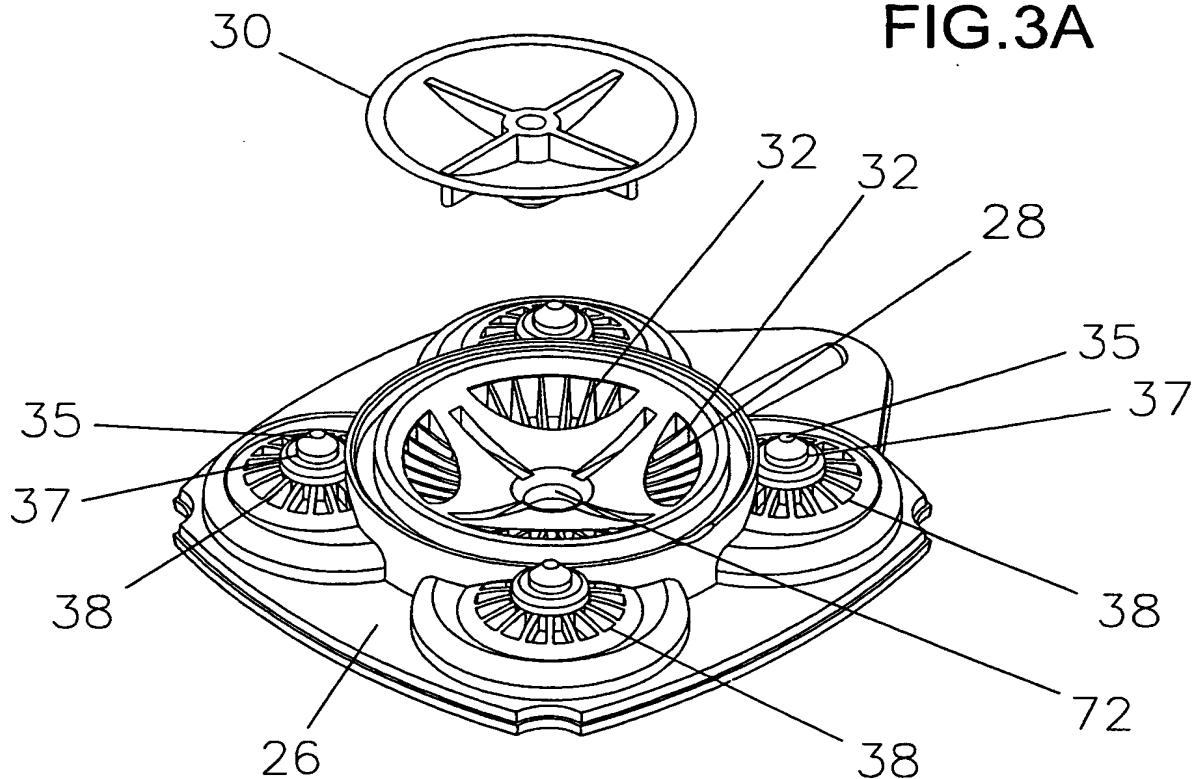
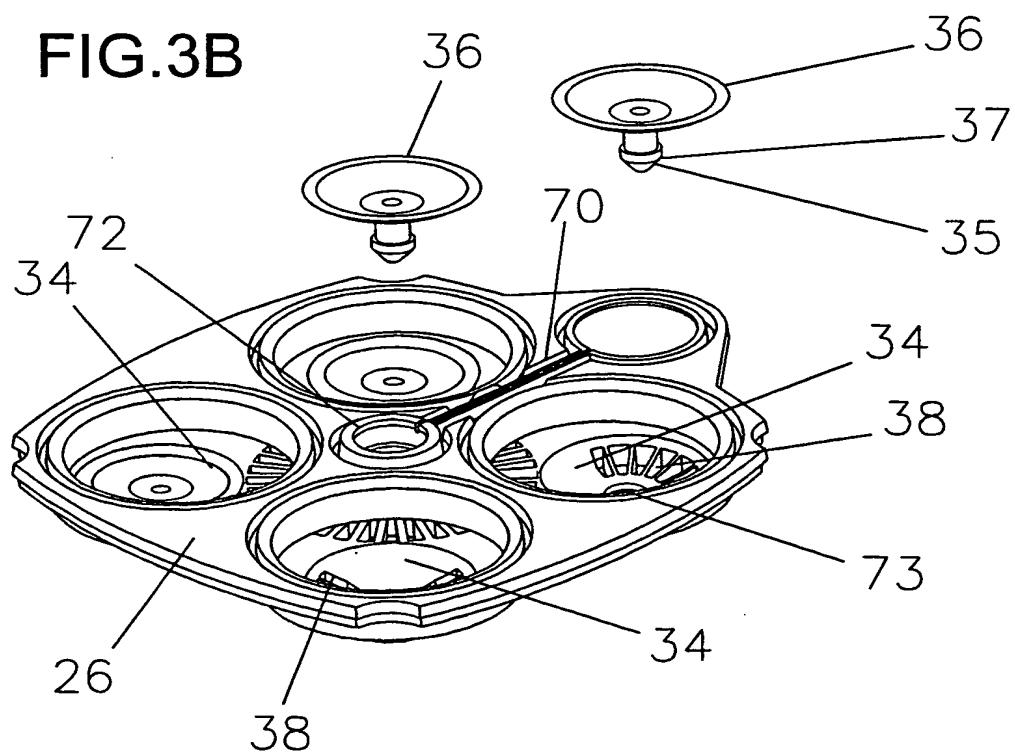
**FIG.2A**



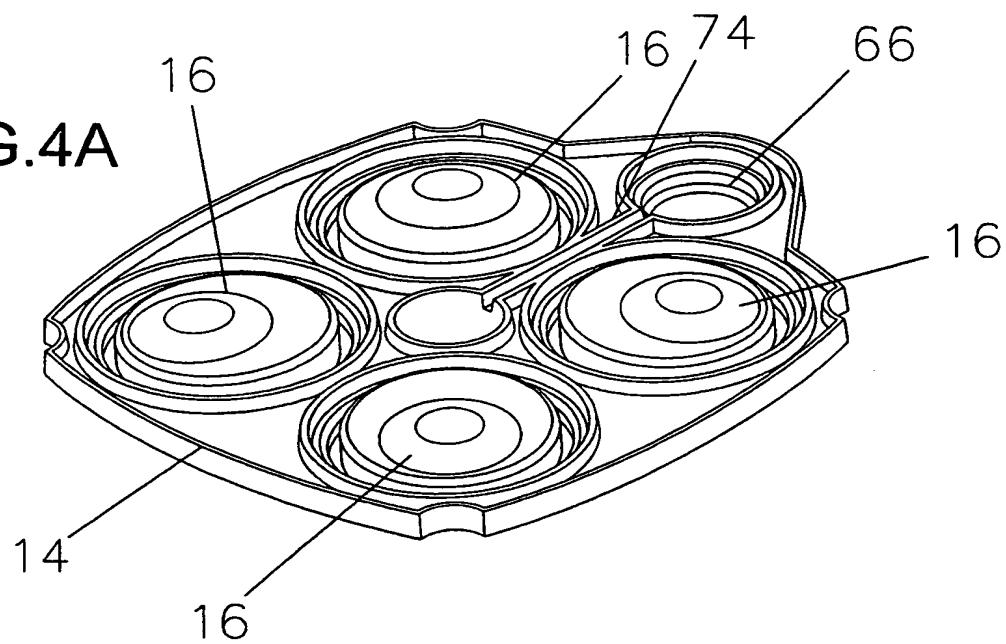
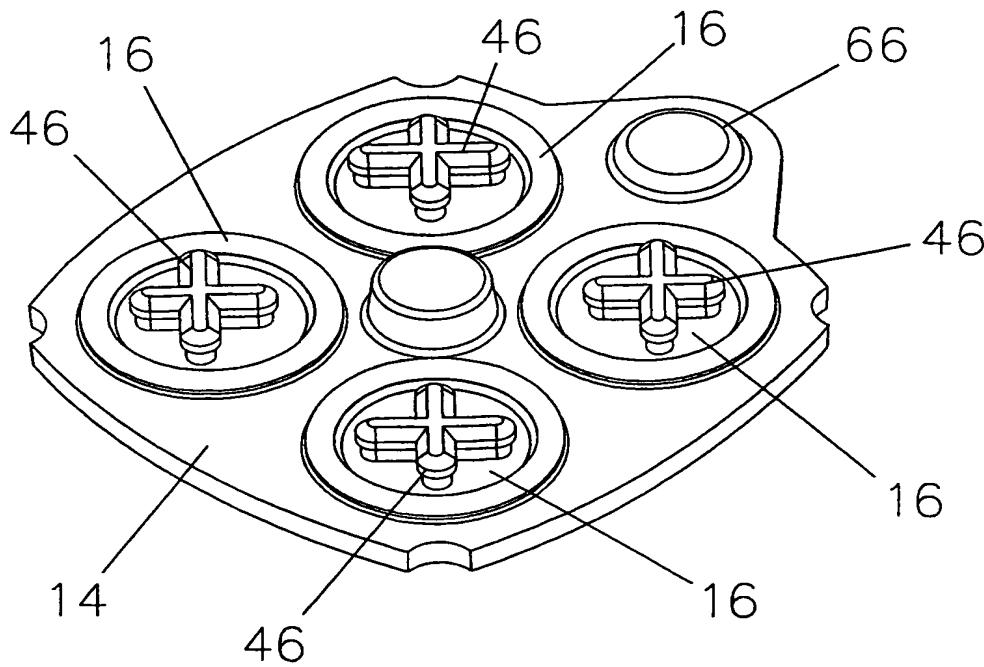
**FIG.2B**



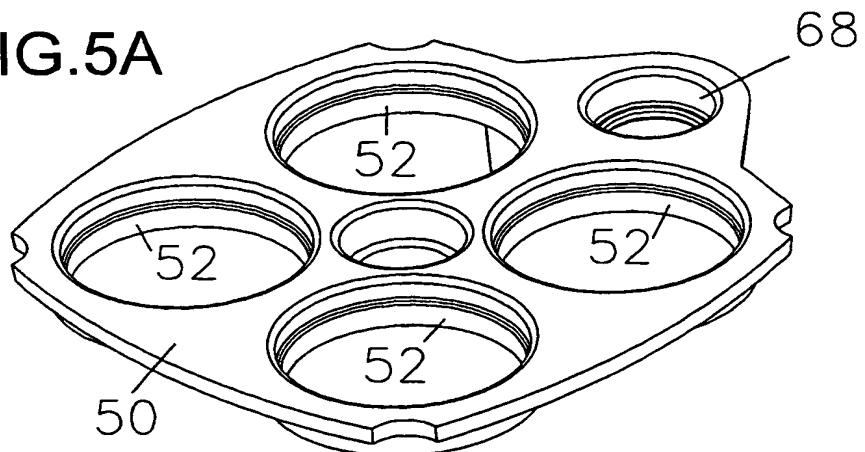
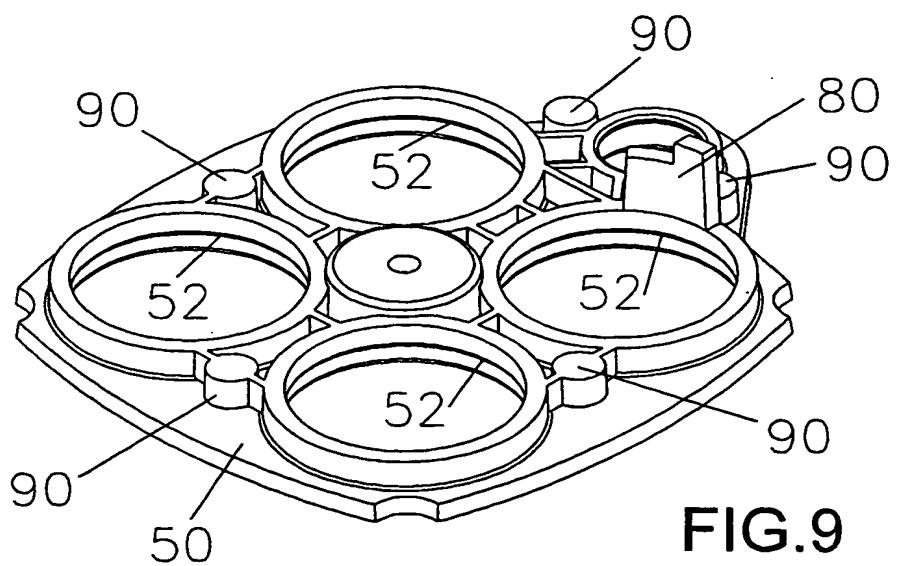
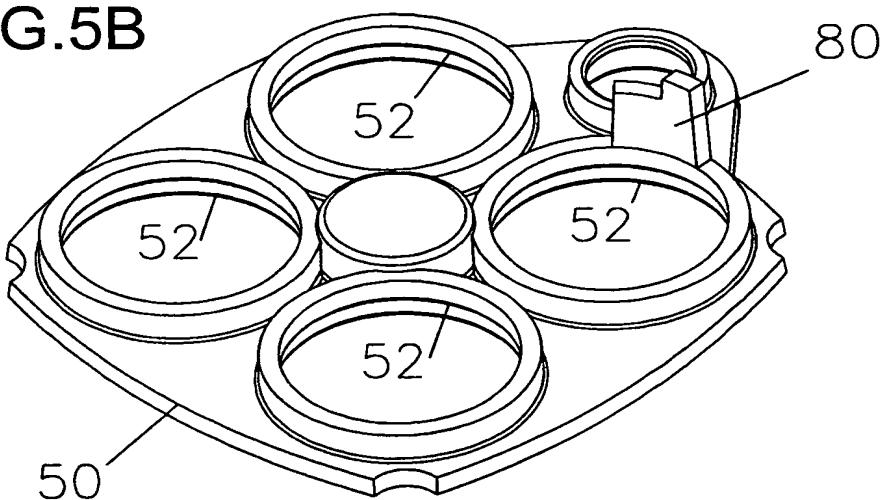
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**FIG.3A****FIG.3B**

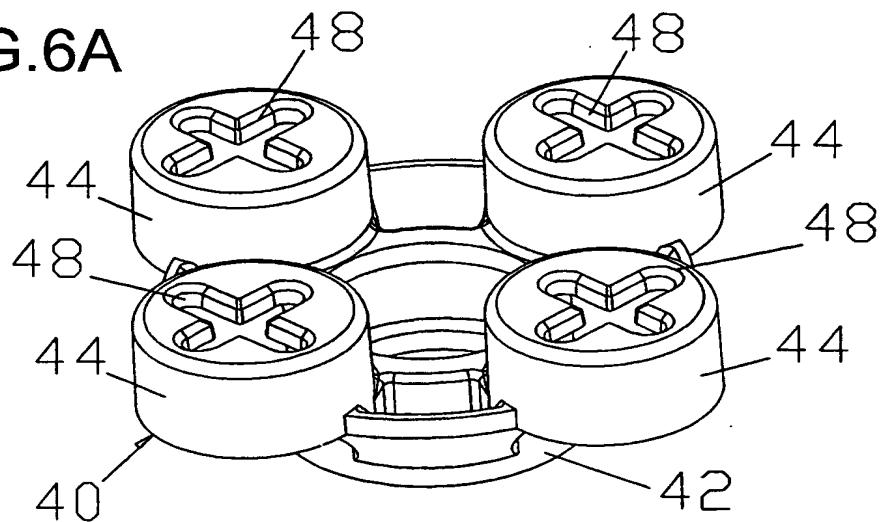
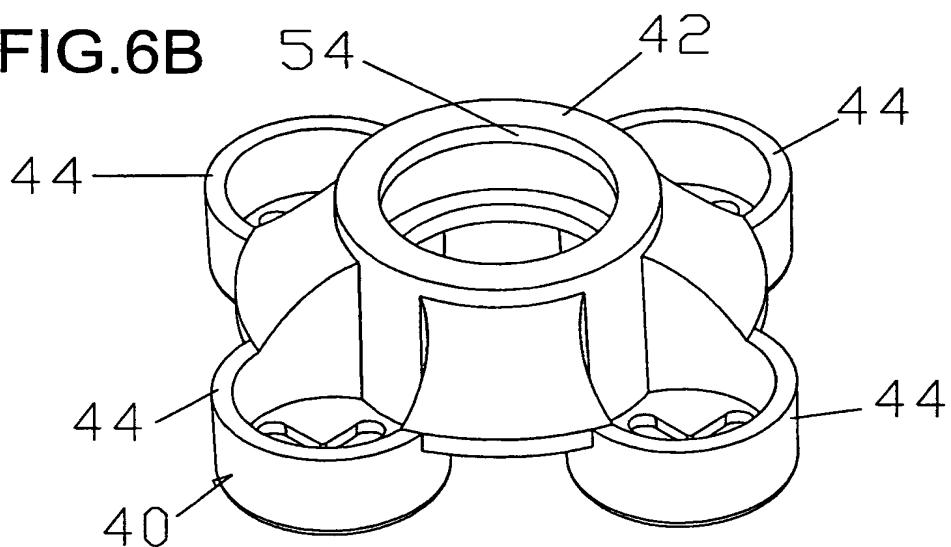
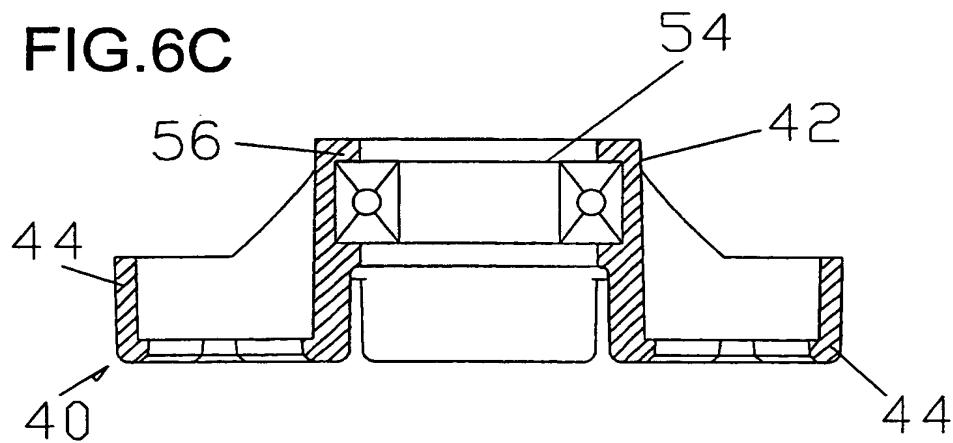
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**FIG.4A****FIG.4B**

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**FIG.5A****FIG.5B****FIG.9**

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**FIG.6A****FIG.6B****FIG.6C**

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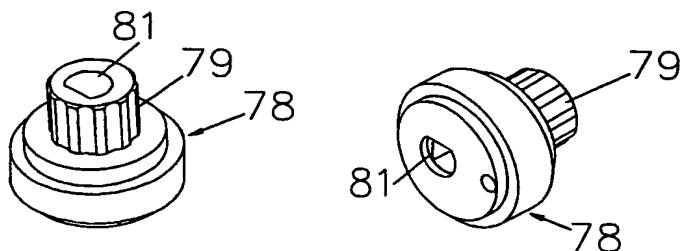


FIG.7A

FIG.7B

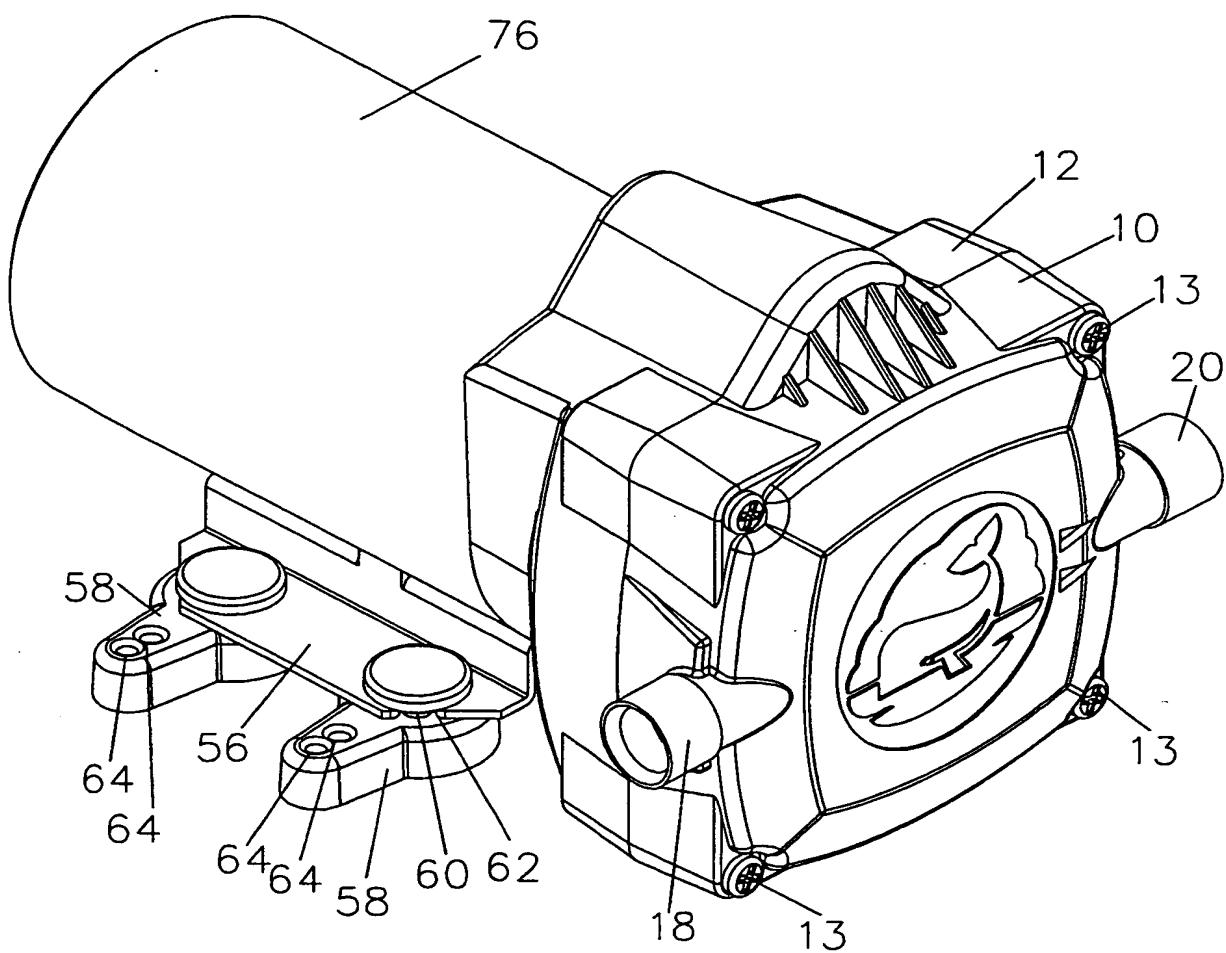


FIG.8

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Unit 3, Weavers Court Business Park, Linfield Road,  
Belfast BT12 5GL (GB). MCFARLAND, Robert, Stan-  
ley [GB/GB]; Old Belfast Road, Bangor, County Down  
BT19 1LT (GB).

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(74) Agent: ROBERTSON, Robert, Bruce, Spence; 240 Up-  
per Newtownards Road, Belfast BT4 3EU (GB).

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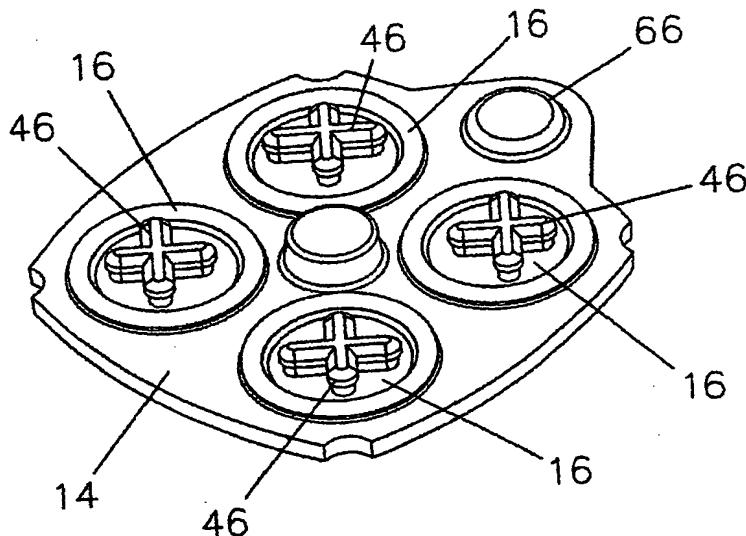
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(71) Applicant (*for all designated States except US*): MUN-  
STER SIMMS ENGINEERING LIMITED [GB/GB];  
Old Belfast Road, Bangor, County Down BT19 1LT (GB).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): MACAULEY,  
Stephen [GB/GB]; Old Belfast Road, Bangor, County  
Down BT19 1LT (GB). EVASON, Michael [GB/GB];

(54) Title: DIAPHRAGM PUMPS



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(57) Abstract: A diaphragm pump comprises a two part casing formed of a front cover (10) and a back cover (12). A diaphragm plate (14) having a plurality of circular regions (16) extends across the covers (10, 12) with axially aligned inlet and outlet ports (18) leading to inlet and outlet chambers (22, 24), a valve housing (26) with a concave resilient disk outlet valve (30) and a plurality of inlet disk valves (36). A wobble plate (40) is positioned in the back cover (12) with a central boss (42) for connection to the electric motor (76). The wobble plate (40) provides a pumping action by a nutating movement which displaces the pistons (44). The circular diaphragm sections have lugs (46) of cruciform shape which are secured to corresponding slots (48) in the pistons (44). The motor casing has a mounting bracket (56) with mounting feet (58) of ovoid shape and resilient material and an integrated pressure switch for stopping the pump by activation of a micro-switch.



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